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Title:	Genetically encoded functional materials: regenerative medicine, optoelectronics, biosensing.
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Genetically encoded functional materials: regenerative medicine, optoelectronics, biosensing.

Controlling the interface between hard and soft (biological) moieties can produce functional materials and assemblies for imaging and sensing, regenerative medicine, and optoelectronics. Vignettes of our work utilizing biological templates to produce molecular-like fluorescent metal nanoclusters, metal- and conjugated oligomer- polymer composites, and libraries of polymers utilized for regenerative medicine will be presented, along with a description of the Center for Integrated Nanotechnologies, a national nanoscience user facility. Briefly, fluorescent metal nanoclusters are gaining much interest because of their desirable photophysical properties, smaller size than quantum dots, and biocompatibility. Recently, we have synthesized and photophysically characterized Ag-nanoclusters (AgNCs), which were templated on DNA, with distinct and narrow excitation and emission profiles tuned to common laser lines. Intrinsically fluorescent recogonition ligands have been created from chimera's of DNA that template AgNC and aptamers, for the specific and sensitive detection of proteins. More recently, we have developed a DNA detection probe (NanoCluster Beacon, NCB) that "lights up" upon target binding. Beyond nanoclusters, genetically engineered polymers enable design of specific and tunable materials properties at the DNA level with control over function and structure unparalleled by synthetic polymers. The precise control afforded by these polymers, coupled with their biocompatibility, programmable assembly, and flexibility, transforms our ability to engineer materials for applications such as "smart skins," and self-healing materials, and for the interfacial control with biological systems. We have created large (10^8) and diverse libraries of genetically encoded polymers and rapidly identified functional materials using a genetic technique akin to evolution. We will present our libraries, selection strategies and downselected polymers that induce mesenchymal stem cells to differentiate toward chondrocytes, without addition of chemicals or extra cellular matrix.